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The Organization And Administration
Of Engineering Extension

THE ORGANIZATION AND ADMINISTRATION
OF
ENGINEERING EXTENSION

BY

KENNETH GARDNER SMITH

B. S. UNIVERSITY OF ILLINOIS, 1935

THESIS

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE

DEGREE OF
MECHANICAL ENGINEER

IN

THE GRADUATE SCHOOL

OF THE

UNIVERSITY OF ILLINOIS

1916



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THE ORGANIZATION AND ADMINISTRATION OF ENGINEERING EXTENSION

CHAPTER I.

ORGANIZATION

The Growth of the Extension Idea.

No one has ever disputed the fact that the main function of a university is teaching the students upon its campus. When a university ceases to be merely a storehouse for knowledge already gained and becomes a producer of new knowledge, it is fulfilling its second great function, research. According to the old idea, quiet, seclusion and separation from the world of trade and industry were considered necessary for the best results in both teaching and research. Teaching was for the benefit of students who could satisfy requirements and attend classes. Research was conducted by members of the teaching staff in order to increase this store of available, teachable knowledge. It was not regarded as a means of direct service to state, country, or humanity in general. The influence of the institution was to be exerted through its graduates, not by direct contact of its faculty with the outside world. The idea of research as a definite form of service and a definite university function came later and was responsible for the

establishment of Agricultural and Engineering Experiment Stations. Productive scholarship became the university ideal. Distributive scholarship was not seriously considered, except as represented in the published reports of investigators.

In this connection it is interesting to note that the first movement in this country toward the spread of popular education was not connected with any educational institution. The organization was known as The American National Lyceum, established in 1831. Lectures and debating clubs were organized in rural and urban communities and many noted men contributed to its success. Over fifty years later (in 1887) an address before the American Library Association stimulated interest enough to start in this country what is now called university extension work. New York made the first state appropriation for this purpose in 1891. All of the work was of a general nature and classified under the title of "Home Education". Academic inertia was then, and is now, difficult to overcome. In the same year a society for university extension was organized in Chicago, but in 1892 The University of Chicago absorbed its ideas and functions. The work proposed was wholly academic and cultural.

The first group of educators to break away from the clannish university organization and to definitely turn their efforts to the problem of the distribution of useful knowledge were the agricultural men. They said that extension policies should be shaped not by class room precedent but by present needs. The very nature of the subject of agriculture made inevitable the development of the extension

idea. Teaching and research involved extension activities, for the agricultural teachers were surrounded with students, laboratories and equipment on every side. They were almost compelled to get off the campus to do their work. Strong men took up the work who refused to be bound by university methods and standards. Some went so far as to refuse to undertake extension work unless given absolute freedom in its development. This made possible rapid (and sometimes too rapid) development. The work as a whole was so successful that in 1910-1913 colleges and universities began to look upon extension work as a very promising kind of activity which ought to be an integral part of, and definitely connected with, the parent institution. Naturally, colleges with agricultural departments were among the first to reorganize extension work and to put it on a sound definite basis; for instance, the University of Wisconsin in 1906, Kansas State Agricultural College 1909, Colorado Agricultural College 1910, Iowa State College 1913, and University of Minnesota 1913. State institutions took up the work either from a desire to be of more service or from motives of self interest or both. The year 1913 brought a large increase in legislative appropriations and a widespread interest in extension work.

It seems to be generally conceded at the present time that a university or college has three functions:

- I. Teaching
- II. Research
- III. Extension

Distributive as well as productive scholarship is recognized. Granting this, the main question and the one with which this thesis deals, is the organization and administration of this third function, extension work, in the restricted field of engineering extension.

Extension Work as Related to General University Organization.

Extension work to be successful on any large scale must be free to develop its own policies and methods, subject to the approval of university authorities. There are three fundamental types of organization.

1. The separate division or department.
2. The subdivision under an existing department.
3. A general college activity under a faculty committee.

In the larger institutions extension work is conducted by a division or department as a unit coordinate with other divisions or departments under a dean or director. Close co-operation with other departments is exceedingly important and desirable in order to make the service of the whole institution most effective. The tendency to divorce extension work entirely from the resident work should be avoided because it bars the resident faculty from a beneficial participation in extension work and because it greatly increases the cost of conducting extension work. To carry on extension work as a subdivision of an existing department is possible, although under these conditions it is too apt to be dominated by the resident faculty. In only eight out of fifty-one in-

stitutions studied is the work conducted by a faculty committee. This is the least desirable of the three methods mentioned because committees are too slow for the prompt decisive action often necessary in extension work and because a resident faculty man rarely has the breadth of vision and business acumen necessary to map out an extension campaign.

At Iowa State College, extension work is administered by two directors, one in agriculture and one in engineering, both of whom are directly under the president. Members of the engineering extension faculty are also members of the engineering faculty and the general faculty co-operates closely in several lines of work.

Department Organization

One of the chief reasons for separating the extension from the resident organization is that the basis of subdivision is fundamentally different. The basis of subdivision in resident work is subject matter; the basis of subdivision in extension work is method. A resident division or college of engineering is divided into electrical, mechanical, civil and other branches of engineering. The same method of instruction prevails in all branches taught. An engineering extension department is divided into sections or bureaus, as the case may be, in accordance with the method used, such as (1) Lecture Study (2) Correspondence Work (3) Class Work (4) Short Courses (5) Motion Picture Service (6) Technical Service Bureau. It is conceivable that in-

struction in every department of engineering represented in the parent institution might be given in accordance with all the methods mentioned, although it is not likely. The reason for making method the basis of organization is that method determines to a great extent two vital factors, cost and success. Geographic location also must be reckoned with as a factor which does not enter into local work. A method well adapted to a certain group may be out of the question on account of the cost to students and department. A good instructor is powerless if the method followed is not adapted to the class of men with whom he deals.

Aside from this division of the organization on the basis of method there is a second basis of division which may be called the geographic basis. The fundamental office and field organization remains the same or develops logically as work demands. The geographic organization varies with courses, methods, general state development and classes of men dealt with. There are however two basic forms of geographic organization which we may term the centralized and district form. In the district form, extension representatives are permanently located with offices in certain cities. Through these district offices all or nearly all extension work in the district is carried on. The central office directs the work through the representative in charge. Naturally, this form of organization is expensive and can be used only when appropriations are large and when there is a large amount

of work to be done. The Milwaukee District alone in Wisconsin requires as much for its support as the entire engineering extension appropriation in the state of Iowa. In the centralized form of organization there are no permanent district offices. Extension workers go from place to place as work demands and their movements are governed entirely from the central office. Combinations of the district and centralized form of organization are possible.

For university extension work with large appropriations the district form is well adapted because the educational field of the university is so broad that a large amount of work may be organized and developed within a small radius. For the restricted field of engineering extension the district form is not well adapted except when important industrial centers offering large opportunities for engineering education are located within the state. In cases where industries are not concentrated, the centralized form of organization must be used. Sometimes, as in Iowa, an extension worker may be located in an industrial center and be responsible for work there and a large surrounding territory. In this case, no expensive office or office force is maintained. These various forms of organization may be clearly shown in chart form.

Figure 1 shows a typical university extension organization comprising field and office force.

Figure 2 shows the geographic organization of this same extension division.

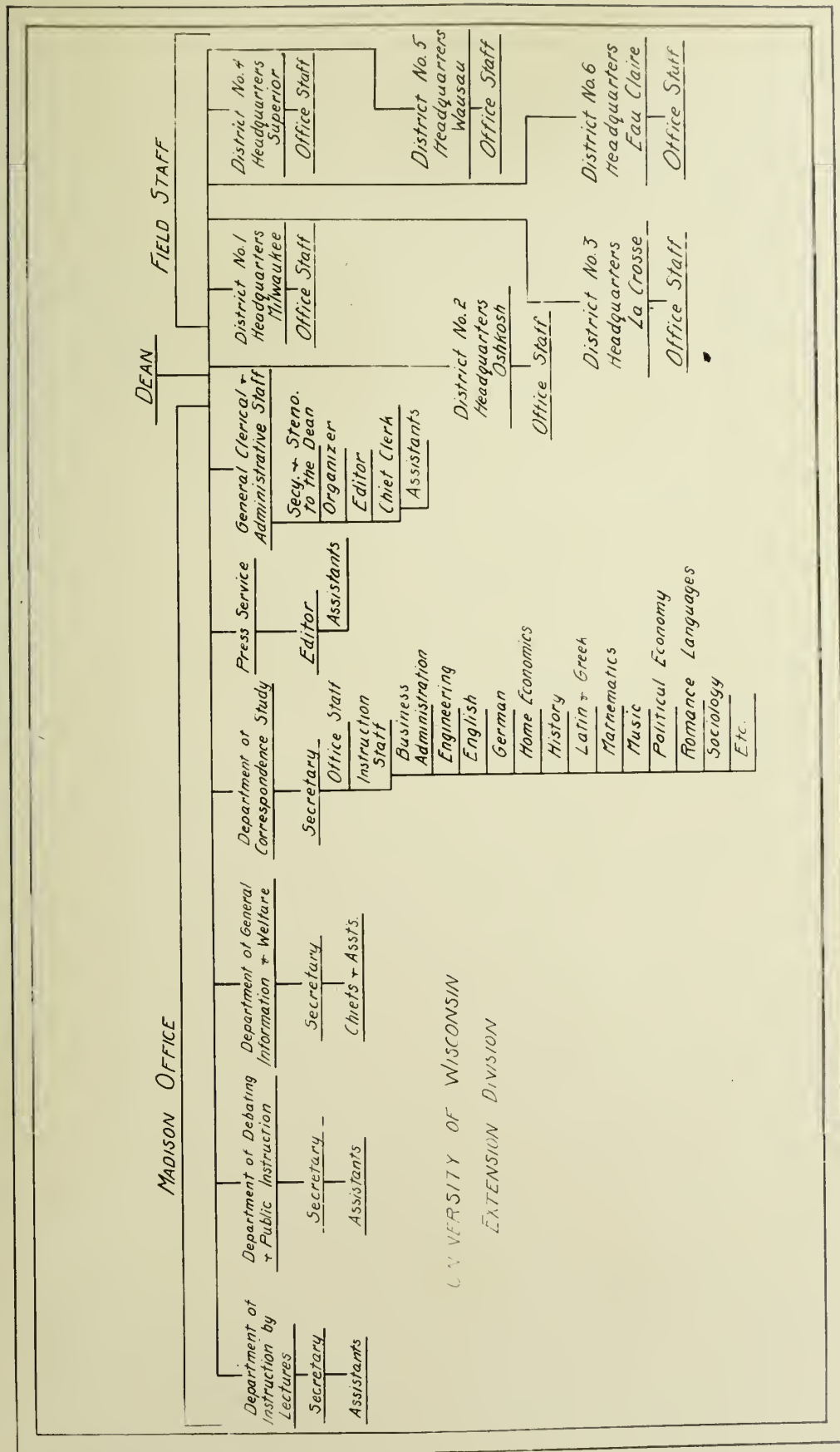


Figure 1.

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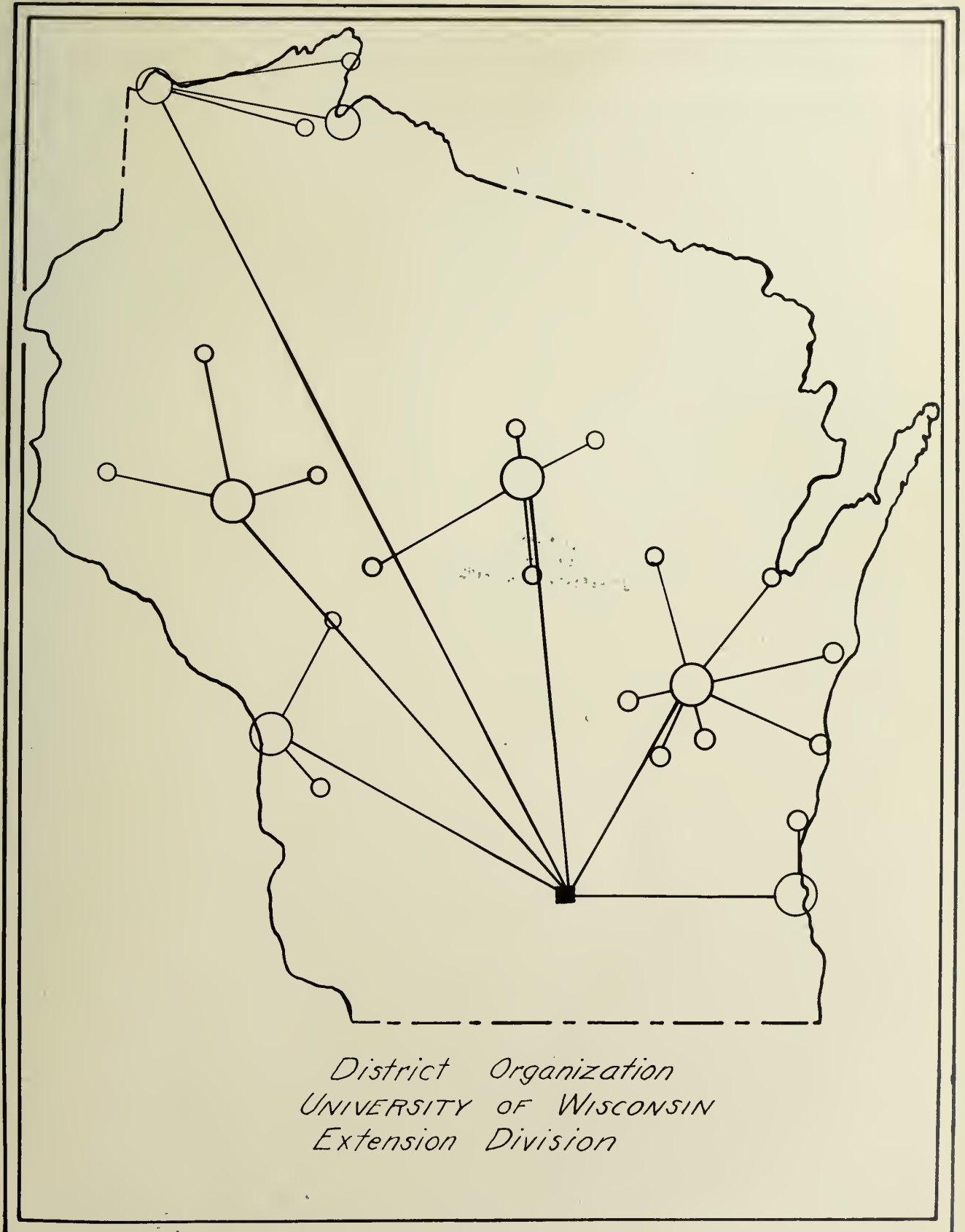


Figure 2.

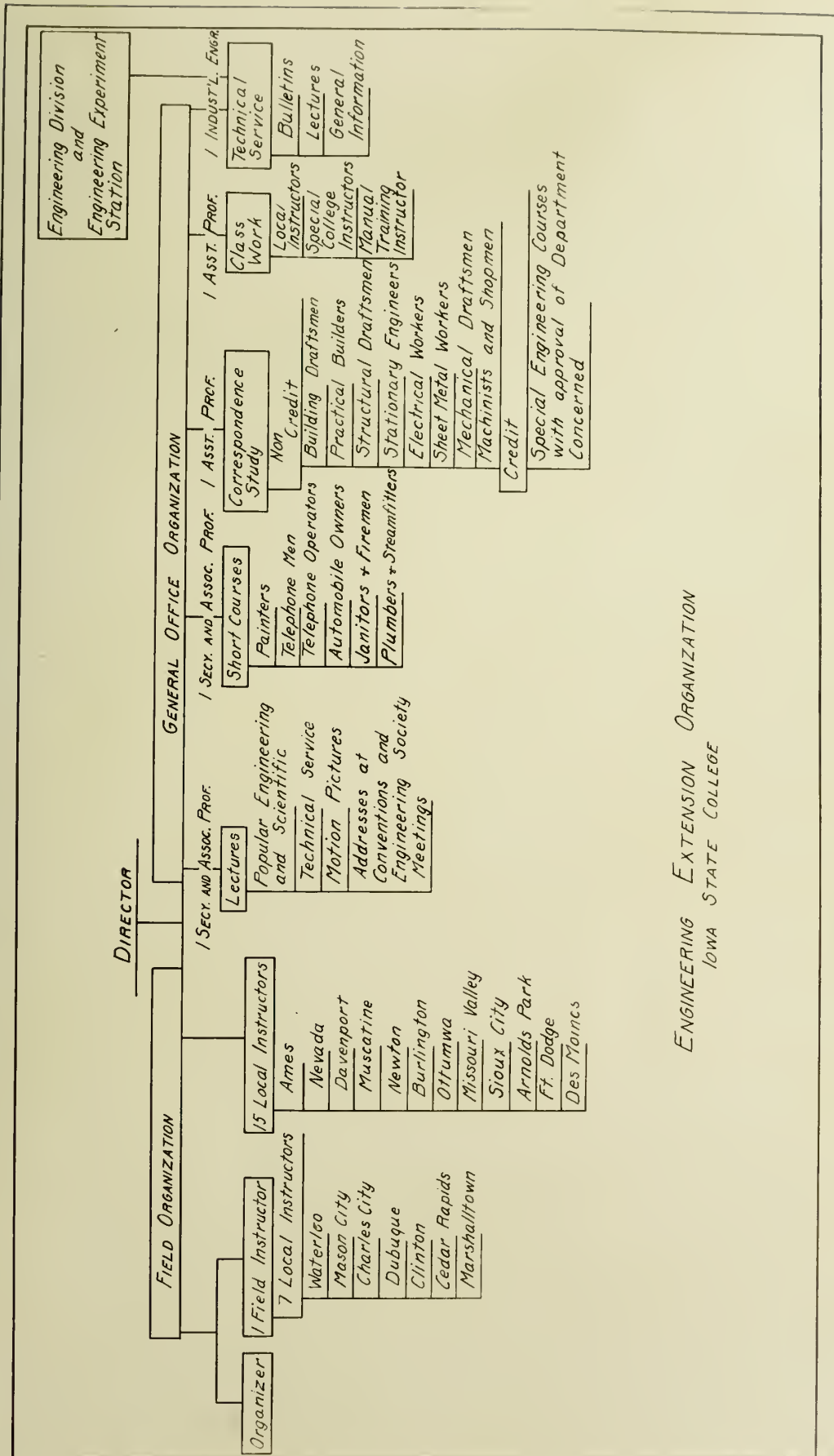
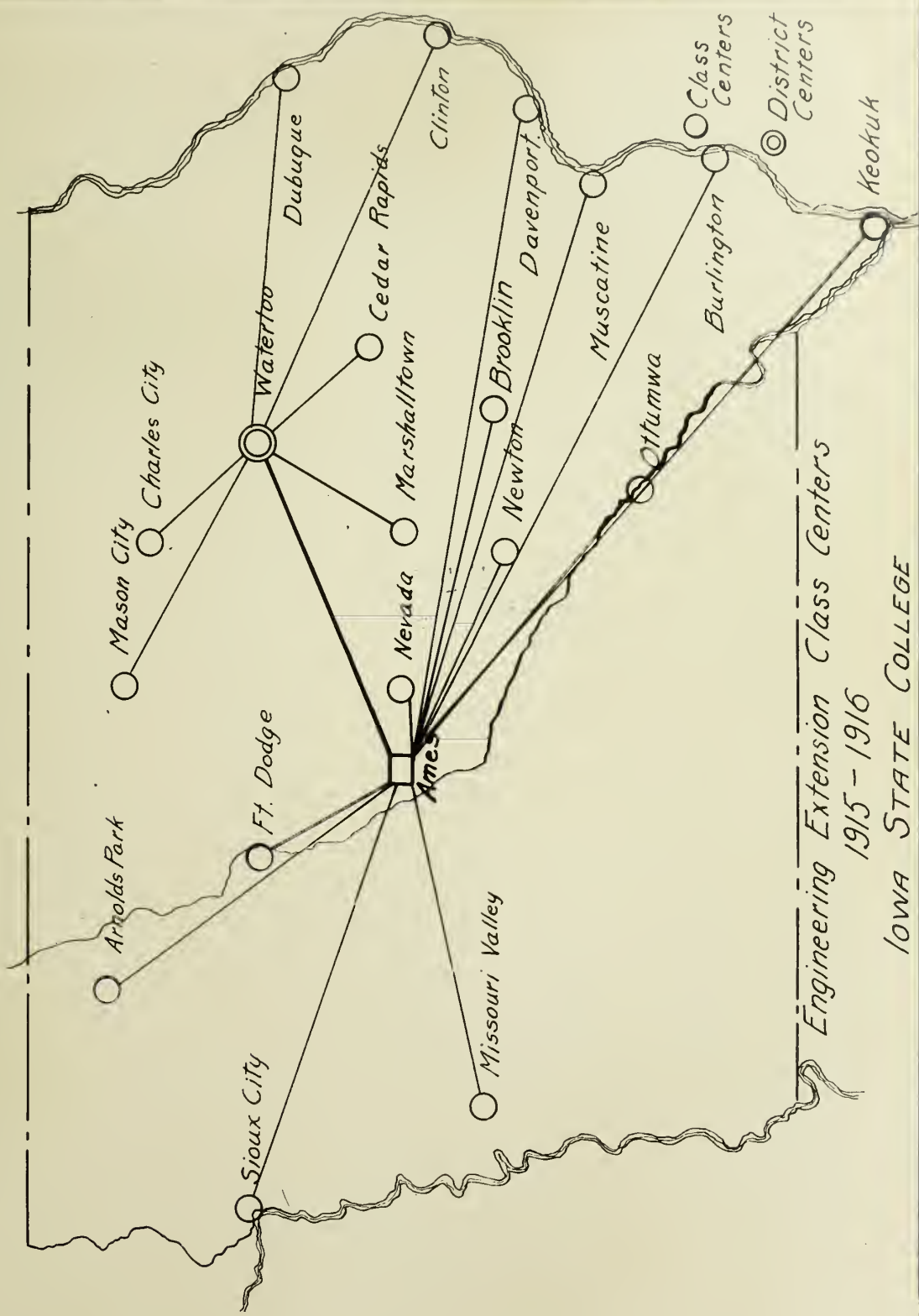


Figure 3.



Engineering Extension Class Centers
1915 - 1916
IOWA STATE COLLEGE

Figure 4.

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Organization and routing for
Telephone Operators and Telephone Plant Men's
Schools 1916.

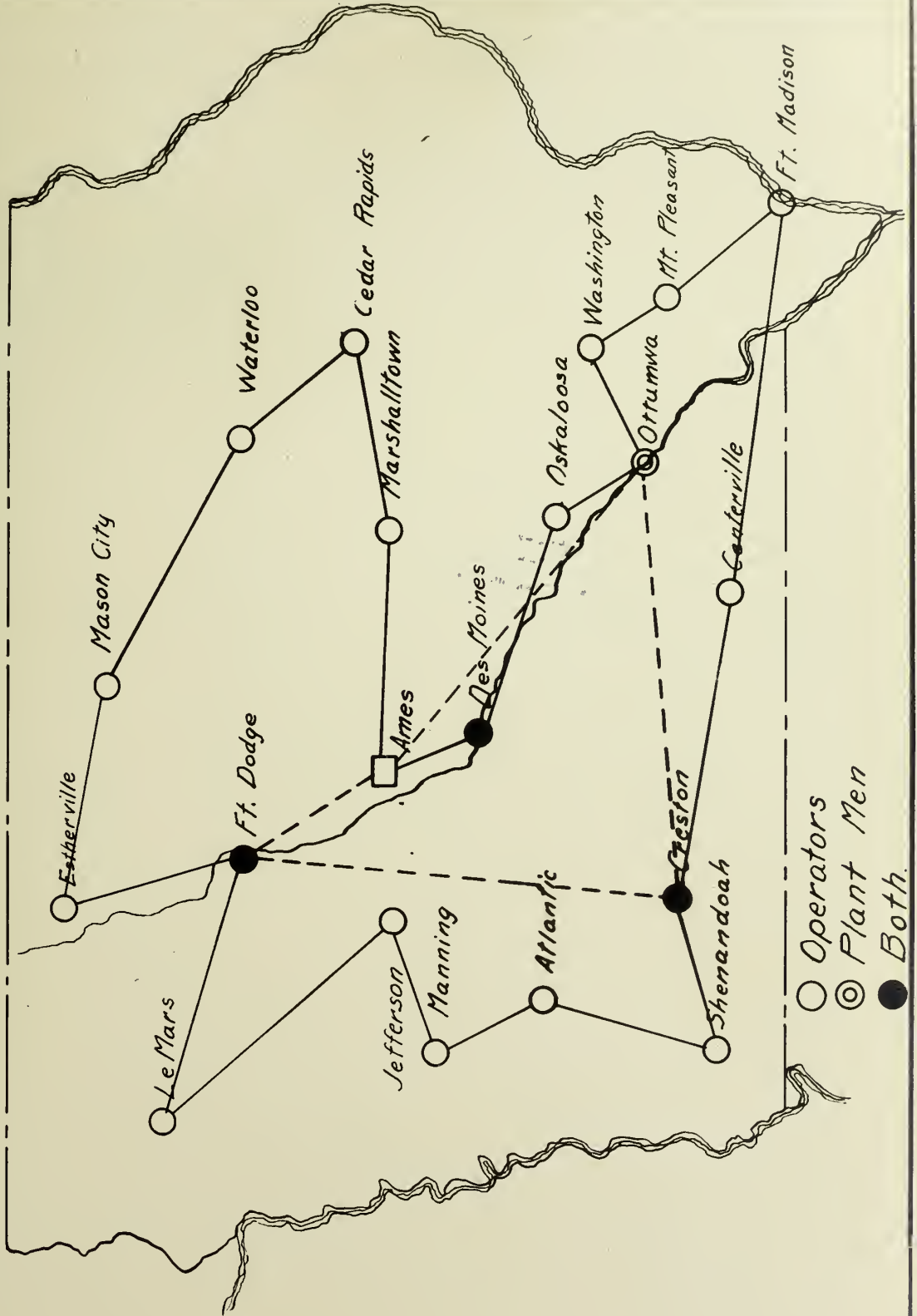
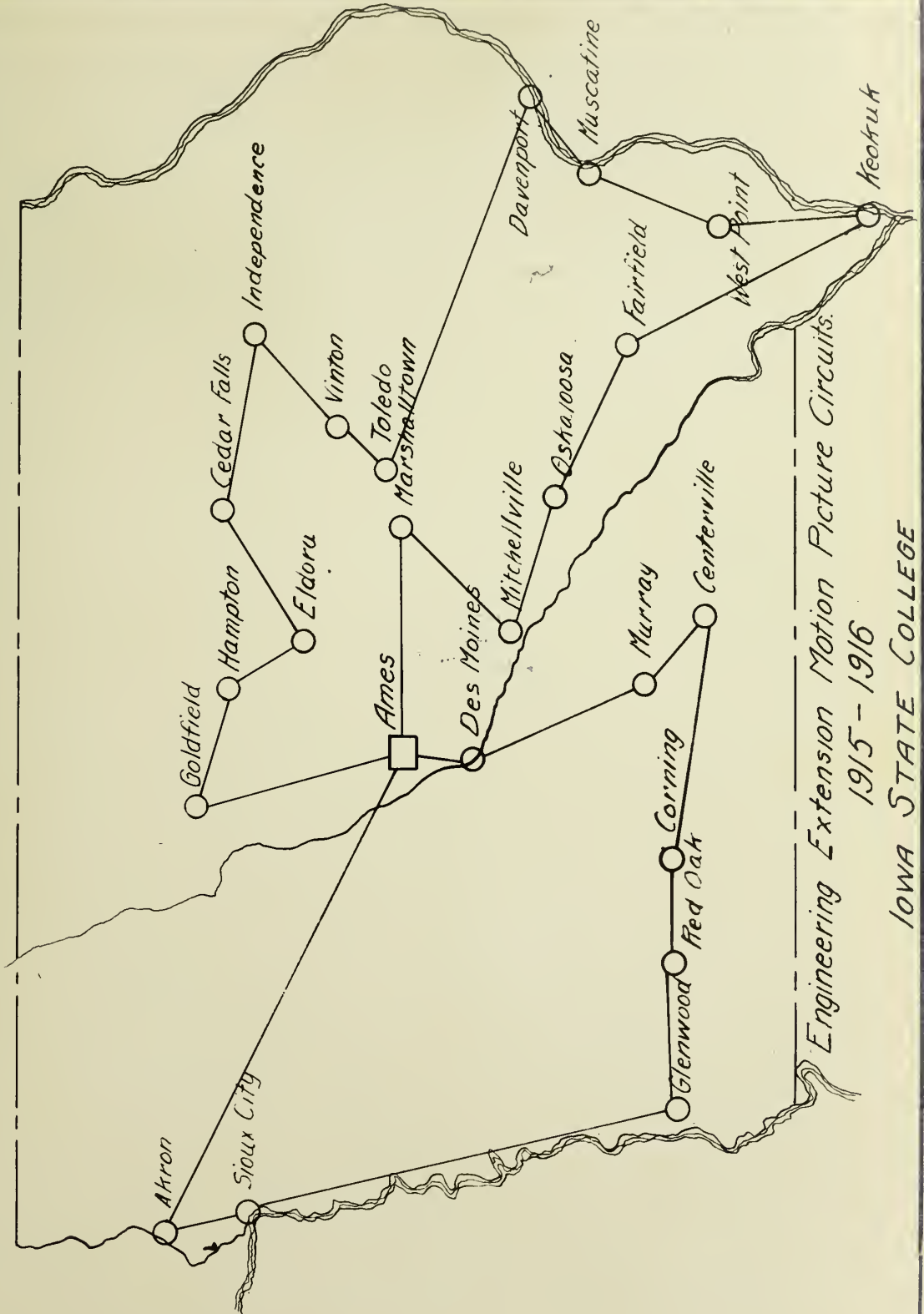


Figure 5.

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Engineering Extension Motion Picture Circuits.
1915 - 1916
IOWA STATE COLLEGE

Figure 6.

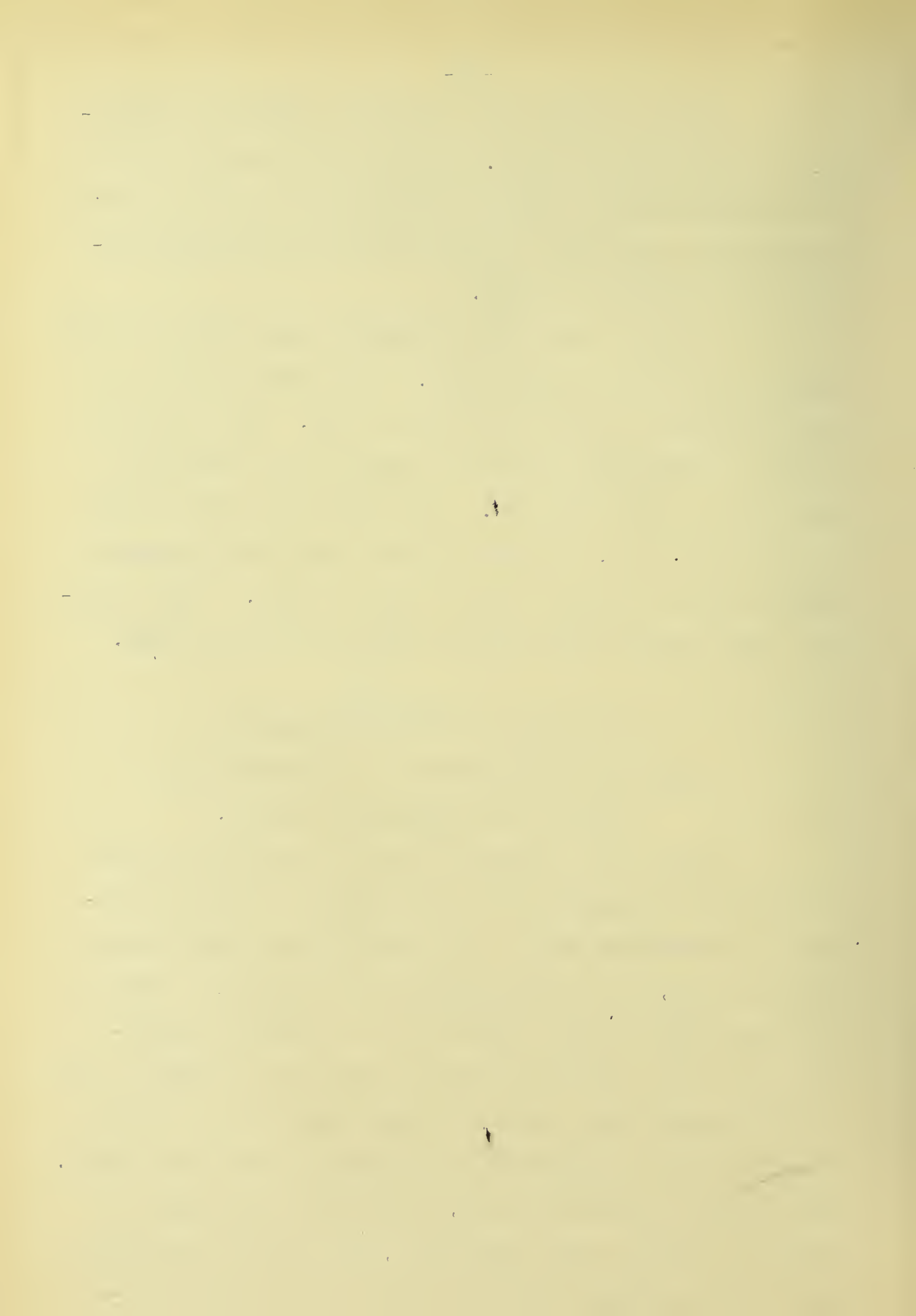
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Figure 3 shows the engineering extension organization of Iowa State College. It will be noted that here the Technical Service Bureau is the connecting link between the Extension Department and the resident Engineering Division and Experiment Station.

Figure 4 shows the geographic organization of this Engineering Extension Department. The organization is of the centralized and not the district form. One extension worker is permanently located in Waterloo and supervises work over a large territory. No office nor office force is maintained here. Figures 5 and 6 show the geographic organization of certain special lines of work. These special lines are directed entirely from the office at Ames.

The Relation of the Engineering Extension Organization to the Engineering Division and Experiment Station.

One of the important questions immediately following that of organization is the precise relation of extension to resident work. Of this relation there are two extreme views, the conservative and the radical. The conservatives say that the function of an extension department is to be a clearing house and publicity bureau for the resident engineering faculty through which they may make their services available in an educational way to the state. The radicals oppose this idea, accuse the faculty man of being too academic and impractical, and say that extension work should be wholly independent and employ its own ex-



perts in all fields of work. Neither of these two views represents a safe and sane attitude and a policy productive of the best results.

It must be recognized at the outset that extension work has in it more of the business and commercial element than resident work and the workers must therefore be free to devise plans and methods. There are two distinct problems, (1) to find and develop, or make a useful field for extension work and (2) to do that work successfully. A resident department has but one of these problems; viz., to do the work presented to it efficiently and well. In extension work the problem of organizing and developing a certain field is often more difficult than the giving of instruction. A man with the ability to organize and ability and sufficient expert knowledge to teach is hard to find. Consequently, an extension department is usually composed of two classes of men, organizers and instructors. Every engineering school has on its faculty expert engineers. The question then arises, "How far shall an extension department duplicate these experts and add organizers and how far shall it be composed wholly of organizers and depend on resident men for instruction work?" The best plan is to furnish all the necessary organizing force coupled with as much engineering ability as possible in fields where the demand for service is greatest.

To keep the connection between resident and extension work from being a haphazard and go-as-you-please

arrangement there should be a definite connecting link. This has been charted (Figure 3) as the Technical Service or Information Bureau. Its functions are distinctly distributive as opposed to productive in the sense of research work. Research work is a function of the resident departments and experiment stations only. One function of the bureau is to look up and develop opportunities for research of particular interest to the state. All matters requiring investigation are turned over to the resident departments. Requests for general information and lectures are best handled by the extension staff. Special technical lectures for special gatherings, especially those dealing with the results of recent experiments, should be handled by members of the resident faculty or experiment station staff. Such an organization as above avoids duplication of experts and renders expert assistance and information available to the industries and taxpayers of the state most efficiently and at a minimum cost.

The Relation of Engineering

Extension to the State.

As the Technical Service Bureau is the connecting link between the Engineering Extension Department and resident departments, so the Engineering Extension Department is a connecting link between resident departments and the state. In building up a state industrially, two things are necessary; (1) natural resources (2) an intelligent

and energetic people. The importance of scientific research in the development and conservation of natural material resources has never been questioned and has already been mentioned as a function of the Engineering Experiment Station. The importance of conserving the energy and intelligence of the people by enabling them to render capable and efficient service in some vocation has not been so fully recognized. Facts discovered are of little use unless they can be intelligently applied in various industries. Knowledge confined to the brain of the investigators or communicated only to superintendents and managers is of little value unless these superintendents and managers are themselves workmen or are in a position to see that facts thus communicated are intelligently applied by trained, skilful and intelligent workmen. Most employers recognize this fact and endeavor in many ways to give their employees the advantage of their own technical knowledge by means of lectures, talks, evening and even day classes. Such methods, unless organized and systematically conducted under competent teachers, do not produce the desired results, save in exceptional cases. In this connection it may be noted that one reason for the great success of agricultural extension work is that the man who can use the facts presented is an employer and easy to reach because he wishes to use the knowledge gained for his own direct benefit. In engineering work, the man who actually uses the facts presented is often one of a

large number of employees who benefit only indirectly by knowledge gained.

In its relation to the state an extension department has a dual function. It is not only the means by which the college reaches out to the state, but it is also the means by which the state reaches in and becomes acquainted with the college. It acts as an interpreter of scientific investigation to the state and also brings to the attention of the college investigators the special problems of the state which, naturally, have first claim on a state institution. In performing this function, the extension department may even be instrumental in establishing new courses in the resident departments by securing the cooperation and support of the representatives of special lines of engineering. At Iowa State College two new courses have been established as a result of extension work, automobile engineering and telephone engineering.

In applying the results of investigations to state problems and in discovering problems of interest for investigation, the Technical Service Bureau is the particular subdivision of the extension organization concerned, and its functions and relations will be fully treated in the next chapter.

* Acknowledgement is due Dr. Louis E. Reber, of the University of Wisconsin, for data on Page 2.

CHAPTER II.

ADMINISTRATION

Preliminary Survey of Field of Work

In the preceding chapter the general principles of organization of Engineering Extension were discussed. Administration consists in the application of these principles to the problems of a certain state after the relations of the department to the college have been determined. We will assume that engineering extension work is to be conducted as a separate department and that the field chosen is that of Iowa as a typical western state.

The general characteristics of Iowa are as follows: The population is 2,358,000, prosperous and well to do; value of agricultural product \$1,000,000,000; value of manufactured product \$406,225,576, according to somewhat unreliable statistics. 95% of the land within its borders is tillable soil, a larger proportion than is to be found in any other state in the union. Naturally, it is preeminently an agricultural state. It is also a great commercial state and, to some extent, a manufacturing and industrial state, with its industries closely connected with agriculture, such as the manufacture of gas engines, agricultural machinery and farm building materials. Slaughtering and meat packing is its greatest industry from the standpoint

of value of output. Coal, clay, gypsum, sand and gravel and building stone are its chief mineral products.

There are no very large cities, the largest, Des Moines, has 105,000 inhabitants. Industries are not concentrated in any one place, though there is only a small proportion of the manufacturing done in the western and southwestern portions of the state. There are few men employed in the skilled trades and few engineers. Only 699 are listed as engineers and surveyors and 1,550 as managers and superintendents of factories. 80% of the engineering graduates of Iowa State College leave the state. There are few consulting engineers and in 1913 there was no commercial testing laboratory in the state. Since that time a small one has been established. Up to 1913 little, if anything, had been done in the way of industrial education. Only 2.12% of men engaged as wage earners had received any definite training for their work. In telephone and automobiles per thousand of population, Iowa surpasses every other state. All industrial and commercial activities are tinged with and depend upon the state's greatest industry, agriculture.

This was the situation in Iowa in August 1913 when the Department of Engineering Extension was established at Iowa State College. In view of these facts the following policy was determined upon in starting the work.

1. To promote interest in industrial education through existing agencies such as public schools, Y. M. C. A.'s

etc.

2. To offer certain courses by correspondence as demand developed.
3. To offer technical and semi-technical lectures for the purpose of conveying information and for the purpose of studying the field first-hand.
4. To aid in developing manual training for rural schools in co-operation with the Agricultural Extension Department.
5. To develop other fields of work and other methods as fast as further study showed them to be advisable.
6. To develop and organize two-year sub-collegiate work. (This is not strictly an extension function and will not be further considered)

To carry out these policies four men were necessary at the start besides the director.

1. Secretary and Assistant Director to take charge of lecture work and general extension development.
2. Instructor for correspondence study and two-year sub-collegiate work.
3. A field instructor for class work conversant with methods of engineering and manual training instruction.
4. A state organizer.

All of these, except the organizer, were necessarily men with engineering training and experience, but with

widely different characteristics, for an extension faculty with its varying activities, demands men of very different types. The above four men represent quite clearly the four fundamental types of extension men. (1) The secretary, a man of ideas and initiative and originator and organizer both in field and office. He should be a good speaker, a good publicity man and capable of turning out a large amount of work in a short time, if necessary, in order to meet a sudden call. (2) The office instructor, a man for detail, careful, persevering, accurate, steady and with capacity to work hard during regular hours. (3) The field instructor, a rough and ready man, hail-fellow-well-met with all kinds of practical experience. He should possess, in short, the characteristics of a good foreman of construction plus engineering training and teaching ability. (4) The organizer, a business man and salesman. He should be preeminently a man among men, of pleasing address and magnetic personality and with a salesman's ability to see the right man to close a contract. Other things being equal, these men should have different training and experience in order to cover as wide a field of engineering as possible. Each should have one particular specialty.

Methods of Instruction.

After the organization has been formed, the next most important question is the methods of instruction to be used, considering the term instruction to cover all sorts

of information given under the direction of the extension department. The methods to be used depend on two things -

- (1) Subject to be treated.
- (2) Character and geographic location of municipalities, industries or individuals to be reached.

There are at the present time five different methods of instruction used in extension work.

- (1) Lectures (including all forms of demonstration)
- (2) Short courses or institutes.
- (3) Class work.
- (4) Correspondence study.
- (5) Bulletins.

These methods will be discussed in turn.

Lectures.

The lecture is the easiest, least expensive, and least effective of all methods when used for instructional purposes before a non-technical audience. If used for entertainment as well as instruction, it may be very effective. Popular scientific lectures do not come within the province of engineering extension. Lectures confined to the field of engineering may be divided into three classes - (1) lectures before technical audiences on topics of engineering interest (2) lectures given for instructional purposes before groups interested in particular topics in engineering or industry (3) lectures before non-technical audiences on engineering problems partaking of the nature of general en-

gineering advice. The first class, lectures before technical audiences, comprises the papers and addresses usually given before engineering societies and clubs. The field for such lectures is very limited. The field for lectures before groups interested in particular topics is not extensive except in large industrial centers where industries are concentrated because there are few topics of general interest to men employed in widely different industries. The educational value of numbers of these lectures is doubtful because the instruction is too disjointed and sporadic to be effective. To make the lectures most effective, they should be accompanied by illustrative material such as actual pieces of machinery, models, diagrams, etc. Lantern slides are, of course, useful and motion picture films are being used more and more. Concrete example and illustration must be the constant aim if the work is to be effective. Lectures of the third class, that is, those given before local groups interested in local problems, such as sewage disposal, water supply, city lighting or city planning, are very effective and are a part of the technical service rendered by the college. In this work the hearty co-operation of resident departments is necessary.

As has been said, the lecture method is the easiest and least expensive method of doing extension work. If lectures are given on a no-fee basis, the traveling expenses should be paid by the local community, except in special cases. The expense to the department is then the worker's sal-

ary. Some universities, notably the University of Michigan, supply the lecturer absolutely free of charge. In others, as the University of Wisconsin, a fee may be charged in addition to expenses.

Class Study.

To make class study a success as a means of extension instruction, three things are necessary. (1) A definite well laid out course of a certain number of lessons; (2) A well organized class; (3) An instructor who has a strong personality and who is in every sense a well equipped teacher.

The course may vary from a carefully outlined standard text book to the specially prepared printed or mimeographed text. Class study may be conducted in two ways, depending upon the subject taught. Subjects like mathematics and drawing must be taught by the individual method. Each man has his own lesson and works upon it, receiving a new lesson or task as soon as the one in hand is completed. Thus, in the same class all stages of advancement may be represented. Even totally different subjects may be taught in the same class. Such a class is not a recitation, it is more like a study hour, in which each student is writing out his own lesson.

Subjects in which there is chance for discussion may be taught by the class method, one lesson being covered at each meeting, and a new one assigned. Written work may or may not be done at the option of the student. According to the plan used in Iowa, written work must be done and an

examination passed if a certificate is granted, and no certificate is granted for class work alone. In a class of this kind the instructor leads discussions, asks and answers questions, and sees that all points are thoroughly understood. No written work is done during the class hour. Such subjects as plumbing, heating and ventilation and gas engines can be taught by this method. The best instructor for class work is, of course, the regular extension man.

Unless classes are held near the central office, or unless there is a district extension instructor, traveling expenses and train schedules will prevent sending a regular extension man as often as once a week to meet a class. In this case, a good live local man can usually be found who will meet classes at so much per evening. When co-operating with public schools and Y. M. C. A.'s, such instructors can more easily be found and often men of experience in this class of work can be secured. One plan the writer has successfully tried is to alternate a local man with a regular extension man, i. e., once in two weeks a regular extension man meets the class. If the course is twenty lessons, he has ten lessons and the local man ten lessons. Sometimes it may be possible for the regular man to take only every third or every fourth meeting, or possibly only two in the whole course, the local man taking all the rest.

When the extension man can be present only at long intervals, the work becomes combination lecture and class work, the regular man giving two or three lectures and the

local man all the class work. The lectures in this case are sometimes summaries of the work up to the present point reached or they may be interesting expansions of the work covered, all depending on the capacity of the class and the character of the course. When the course is one of many, conducted by a city night school, the lecture by the extension man may be made an interesting feature for the whole night school and not for his class alone.

To sum up class study as a method of instruction, it is exceedingly effective, adapts itself well to co-operative plans with local agencies, but requires definite courses and careful supervision from regular extension men. It may be combined very effectively with lecture work and correspondence study.

Short Courses.

The short course is distinctly an agricultural extension development and it by no means follows that it will be equally successful as an engineering extension feature. The two main reasons for this are: (1) The diversification of industry, making impossible subjects of common interest to large bodies of men. (2) The fact that few engineering subjects can be treated in an elementary manner in a short time. An engineering extension short course, to be successful, must be highly specialized and adapted to the needs of one particular group or trade. It should include not only lectures but demonstrations, exhibits, class work, serious study and investigation or actual manual work on the part

of those taking it. The instructor must be an expert who has a single definite aim and who bends all his energies toward attaining it. Such a course is not an educational tonic but a dose of highly concentrated medicine to be given by a competent physician. If the course is advanced, instruction may be given by lectures only, but the same rule of definite aim and specialization holds good. A short course for tradesmen should not consist of lectures but rather of actual practice on some special trade feature under expert instructors. In the Iowa State College extension course for painters and decorators, for instance, instruction is given in graining, stenciling, and tiffany and is confined to these three lines. In the course for telephone men the instruction is confined to special topics of interest to the plant men, linemen are not included.

Short courses cannot be organized for all trades and groups. The following are the conditions and characteristics which make successful courses possible.

- (1) The trade must be capable of sub-division into special topics in one or more of which instruction can be given.
- (2) The trade must require manual skill, technical knowledge or both. In other words, it must have an educational content.
- (3) The materials and equipment must be at hand or such as can be provided without too great expense.

It goes without saying that a careful study of conditions in the trade as to character of men, support of organizations, number of men in the industry, and their desire for further training must be made before short courses are offered, if their success is to be at all assured. Some of the groups for whom such courses have been successfully given are the following: stationary engineers, janitors, and firemen, steamfitters, furnace men, telephone plant men, telephone operators, cement and concrete contractors and clay workers. The most popular short course ever developed in Iowa was the one for automobile owners. Its success was, no doubt, due to the interest of the Iowa farmer in the automobile.

The short course is a very effective way of reaching special groups of men for a brief length of time, but requires careful preparation, organization and supervision. The instruction may vary from that suited to a craftsman to advanced engineering practice. The short course should never be used for or given to men not actually engaged in the work concerned. It is not a short-cut for men who desire to enter a certain field but is intended only for men already engaged in a particular line of work who desire to improve themselves. This rule must be rigidly observed or such courses become a detriment rather than a benefit to industry and engineering. In conducting these courses it is usually expected that fees collected will cover practically all expenses except the salary of instructors.

Correspondence Study.

Correspondence study is a method of instruction too well known to need explanation. In elementary work this method is not efficient because the percentage of failures and drops is too high. In advanced work it may be made very effective. There is no reason why a number of engineering courses cannot be given in this way, especially those which do not involve special laboratory work. Unless large appropriations are available, correspondence study cannot be conducted on a large scale because the clerical and office force required is large. More people can be reached by other methods and at less expense, though perhaps not so thoroughly and effectively. The great opportunity for correspondence study at the present time seems to be in the arts and science courses, not in engineering courses.

Bulletins.

The bulletin is also a familiar form of extension work, so familiar in fact that it is often not considered an extension method at all. The most recent and interesting development in this work is in connection with the Engineering Experiment Station of Iowa State College. The Extension Department, represented by the Technical Service Bureau, is the sales organization for the Experiment Station. It advertises, popularizes and assists in distributing experiment station wares as well as its own particular products. To bring this service before the state, the extension department published a bulletin entitled "What Iowa State College

Can Do for Municipalities". This was a plain statement of what the experiment station and extension workers could do in the way of bulletins, advice and tests. It was a catalog of wares so to speak. This was followed by other extension bulletins of a simple and interpretive character embodying the results of investigations of interest in special lines. No technical bulletins are published by the extension department. These are left entirely to the experiment station. The following are some extension bulletins already published.

What Does Your Auto Cost You?

Some Points on Carburetion.

The Wear and Care of Automobile Tires.

The Oiling of City Streets

Ornamental Post Lighting of City Streets.

The Collection and Disposal of City Refuse.

Street-Name Signs.

The Operation and Care of Sewage Disposal Plants.

A Gas Engine Trouble Chart.

The Blistering, Scaling, Cracking and Non-Drying of Paint.

The Opportunity at the Switchboard.

Motion Pictures in the Schools.

The Depreciation of Telephone Apparatus.

Manual Training for Rural Schools
Parts I, II, III, and IV.

Practical Books for Practical Men.

The character of these bulletins is apparent from their titles. In getting them out, the department searches for fields in which plain, concise information is lacking and endeavors to get that information to the public in readable form. In this the department is strictly an opportunist. Should questions calling for research arise, these are turned over to the Experiment Station.

In Iowa, need arose for a special series of bulletins on manual training for rural schools, due to the fact that a state law made the teaching of manual training compulsory in all schools. To meet this need the Departments of Agricultural and Engineering Extension combined efforts and published four carefully graded bulletins containing manual training projects for rural schools. Their success was immediate and the first bulletin was reprinted three times. The total number of copies published and distributed being 25,000. Bulletin 2 was printed twice, the total edition being 10,000. In this work the engineering department furnished drawings and did all technical work and the agricultural department paid for printing and distribution. Practically all of the material has now been loaned to the State Department of Public Instruction for use in a state course of study.

The Technical Service Bureau.

So far the more definite organized methods of instruction for different distinct groups have been described. Aside from the problems attacked by these methods, there is

the larger problem of educating the public on engineering questions. Bulletins are of great assistance in this work, but to definitely organize it and to bring to bear upon it the experience and expert knowledge of the entire engineering faculty and experiment station staff and to connect them definitely with extension work, is the duty of the Technical Service Bureau. This bureau is organized jointly by the Engineering Experiment Station and extension departments bearing the relation, previously suggested, of a manufacturing plant and sales organization. The bureau has three main functions.

- (1) To educate the public to the need of competent engineering service.
- (2) To give such preliminary expert advice as will lead communities, firms and individuals to see the advisability and desirability of employing competent and well paid engineers.
- (3) To make available to the state the services of the experiment station in such form as to be useful to the average man as well as the engineer.

These services consist of preliminary expert advice and tests made in the station laboratories and reports of such investigations in bulletin form.

The head of the bureau, as chief executive, edits all extension bulletins, sees that engineering inquiries of all sorts are answered and that technical lectures are pro-

vided for conventions and special meetings, sometimes from the extension staff and sometimes from the resident faculty. He also provides newspaper articles for distribution in the state on topics of general engineering interest and promotes all engineering phases of civic improvement. In his files are package libraries of pamphlets, journals and bulletins containing the most up-to-date information on topics for which there is the greatest call. In short, his duty is to keep the college in touch with the state and the state in touch with the college on all questions of engineering importance. With organized short courses, correspondence study and industrial work he has no definite connection except at times when he serves as an instructor or lecturer.

The position of such a bureau is a delicate one touching on one side the college and on the other the practicing engineers of the state. Here, as elsewhere, the secret of success is co-operation. For this purpose an advisory committee of fourteen of the representative engineers of Iowa has been appointed. With these men, the bureau is in close touch and they pass upon all questions of its relation to practicing engineers. Complete records are kept of all trips and summarized reports furnished to members of the committee. Members of the committee also make valuable suggestions on topics for investigation and subjects for bulletins.

In one field of work, in Iowa at least, there are no consulting engineers and the demand for definite expert

advice has been insistent. This is the field of motion picture and stereopticon equipment for schools. As a part of the technical service work, machines have been tested, information gathered and expert service on installations rendered to some fifty schools in the state which have purchased or expect to purchase such equipment. Sometimes special trips have been necessary in order to inspect a building or hall in order to determine the type of machine best adapted to the work. One machine, manufactured in Iowa and new on the market, was tested by the department and fourteen suggestions made for improvement, all of which were adopted by the manufacturer in a new model.

Like many other enterprises, the success of a technical service bureau depends upon its chief. The qualifications of the man for such a position are apparent. He must be an engineer of standing in his own specialty, a good speaker, a good mixer, a good technical writer, a man who can see opportunities for service and who can plan and execute accordingly.

Naturally, the widespread activities of an extension department bring it in touch with individuals and organizations of all kinds throughout the state. Prejudice on the part of these individuals and organizations must be met. The policy of the department should be to work with existing agencies, chiefly the public schools, in definite educational work, and with manufacturers' organizations, commercial clubs, city councils and engineering societies in tech-

nical service work. This means in many cases placing part or all responsibility on the local organization. If this cannot be done at first, it should be the aim to bring it about as soon as possible. Any one of three plans can be followed.

- (1) All responsibility on the Engineering Extension Department.
- (2) Joint responsibility.
- (3) All responsibility on the local organization or community.

These plans apply chiefly to the definite organized courses and lectures and not so much to technical service.

Fees, Salaries and Apportionment of Funds

Co-operation in extension work has just been mentioned. Co-operation should mean and often does mean a sharing of expenses. Extension work may be done on the basis of a free service to the people of the state, but if so done is rarely appreciated as it should be, especially if the services rendered are such that the results can be measured in dollars and cents. The simplest method of causing a community or individual to share responsibility is to charge a fee. The fees, however, must vary with the kind of work done and the class of men to be reached. For correspondence study, fees are fairly well established. Some institutions, such as the Agricultural and Mechanical College of Texas, base their charges on length of time, the fee for one year's work

being \$1.00. The University of Kansas charges a regular rate per term or semester exactly as in resident work. Wisconsin, Iowa, and the University of Washington base their charges on number of lessons, the uniform price being 50¢ per lesson with certain discounts if several courses are taken or successfully completed. The basis of fees for class work and short courses is usually cost of service exclusive of the salary of the regular extension man and central office overhead or administrative cost. This means traveling and hotel expenses of instructors and cost of material or lessons furnished. For single lectures the custom varies. Some institutions, as Iowa State College, forbid the charging of any fee beyond that of expenses. In Wisconsin a lecturer determines his own fee varying from expenses only to \$50.00, depending on the popularity of the lecturer. In technical service work at Iowa State College, traveling and hotel expenses must always be paid by the local organization concerned whenever personal investigation is necessary. Some traveling expense for promotion work and general investigation of opportunities and for trips outside the state is paid from department funds. In starting work, traveling and organizing expenses are always higher than when the work is well established. When an activity, such as furnishing motion picture programs, involves the payment of a considerable amount in transportation charges, this expense is borne by the community receiving the service.

The cost of extension service is always an important matter and there is no work in which efficiency is more

necessary than in this work. The following are approximate costs of various kinds of extension work outside of salaries of regular extension employees and organization work.

Technical Service

All traveling expense paid by communities or firms served.

Technical Service or

Extension Bulletins

3000 copies, average size \$ 60.00

Short Courses

For tradesmen, involving manual work.
One week, material, transportation, advertising and labor, 30 in group, per man 5.00
Salary of instructor paid by department.

Short Courses

Without manual work, minimum of 20 in group, per man 1.00

Correspondence Courses

Per course of 10 lessons 3.00

Average cost of postage, lessons, text, envelopes, etc.

Lectures

No cost if traveling expenses are paid.

Class Work

For twelve weeks with minimum of 12 students, per student 3.00

The above assumes that each student purchases his own text book. The cost of local instructor is reckoned at \$2.50 per meeting and one meeting per week. The margin of \$6.00 is for incidental expense on class records, certificates, etc., and may be necessary for salary if instructors

must be paid a rate of \$3.00 per evening.

Technical Institutes.

1 week each, traveling and hotel
expense, and transportation charg-
es on equipment and advertising,
per week \$ 60.00

Motion Picture Service

Exclusive of equipment of films,
machine, etc., for a circuit of
50 schools during winter season 150.00

As an example of apportionment of funds, the fol-
lowing table shows the expenditure of the Engineering Exten-
sion Department of Iowa State College during 1914-1915. This
budget includes expenditures for two-year resident work as
well.

Salaries	\$14,955.83
Office help	1,993.95
Travel	2,002.99
Heat and Light	630.00
Postage	450.04
Printing	819.29
Furniture and Equipment	364.59
Books for Courses	472.26
Local Instructors	639.00
General Supplies	1,128.92
Labor	290.20
Freight and Drayage	258.01
Telephone and Telegraph	92.13
	<u>\$24,107.21</u>

The following table shows expenditures made for extension work alone:

Salaries	\$10,568.30
Office Help	1,623.80
Travel	2,002.99
Janitor	180.00
Postage	819.29
Equipment	314.00
Books and Courses	472.26
Dept. Supplies	789.52
Labor	274.80
Freight and Drayage	147.01
Local Instructor	639.00
Telegrams and Telephone	92.13
Office Supplies	161.62
	<u>\$18,534.76</u>

The proportions are shown graphically on the accompanying charts. Items for equipment and furniture are large because at Iowa all these are purchased from department funds. Janitor service and fees for heat and light are also deducted from department funds each year. The chart of expenditure by months indicates clearly the fact that extension work increases to a maximum and then decreases. The summer months are employed in getting out bulletins and courses and in planning campaigns.

Taking the total expended as a basis a good extension department should definitely reach one person for every dollar expended after the work is established. As the work

grows, more should be reached for the same money.

THE HISTORY OF THE

1780

1781

1782

1783

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THE HISTORY OF THE

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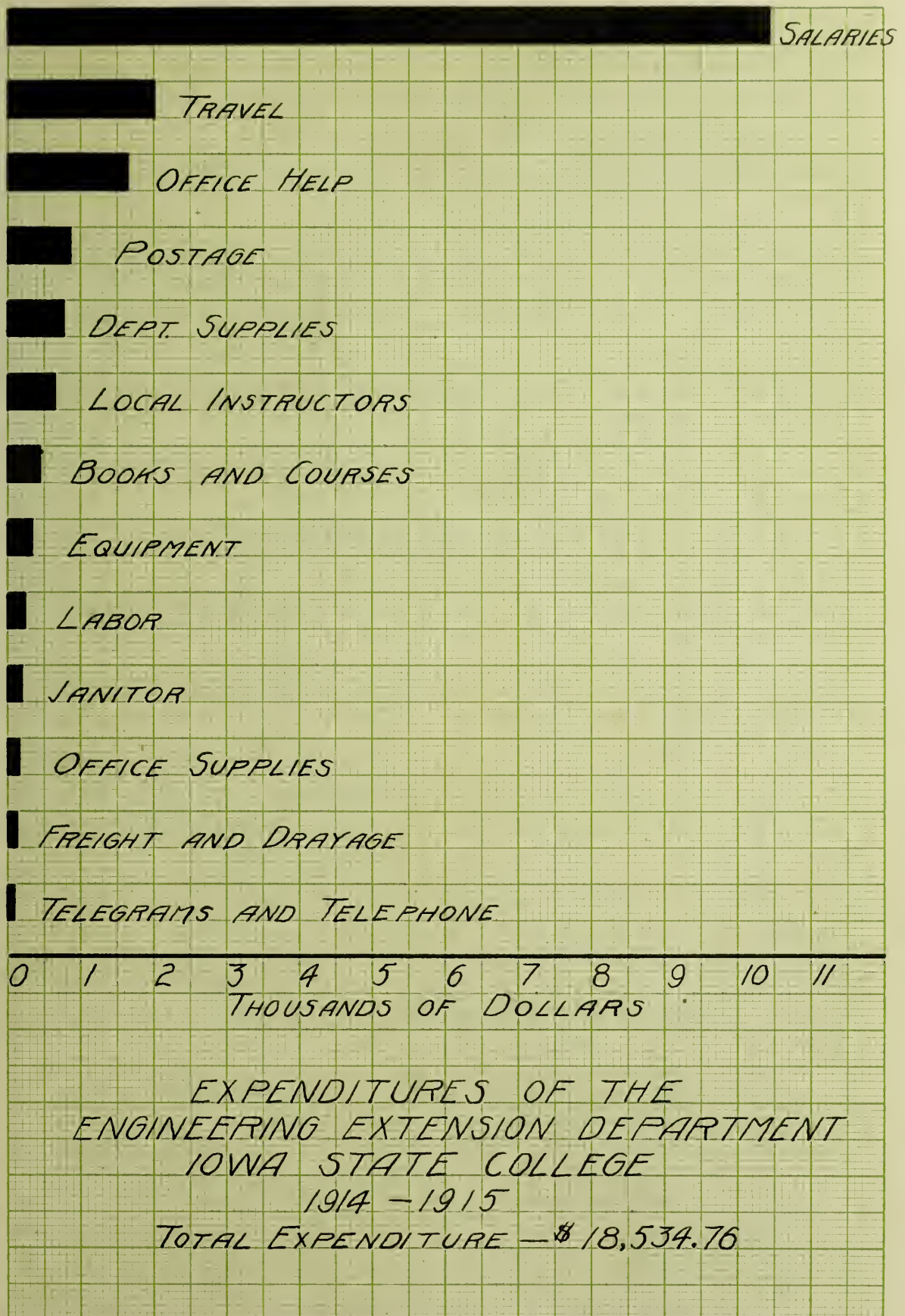


Figure 7.

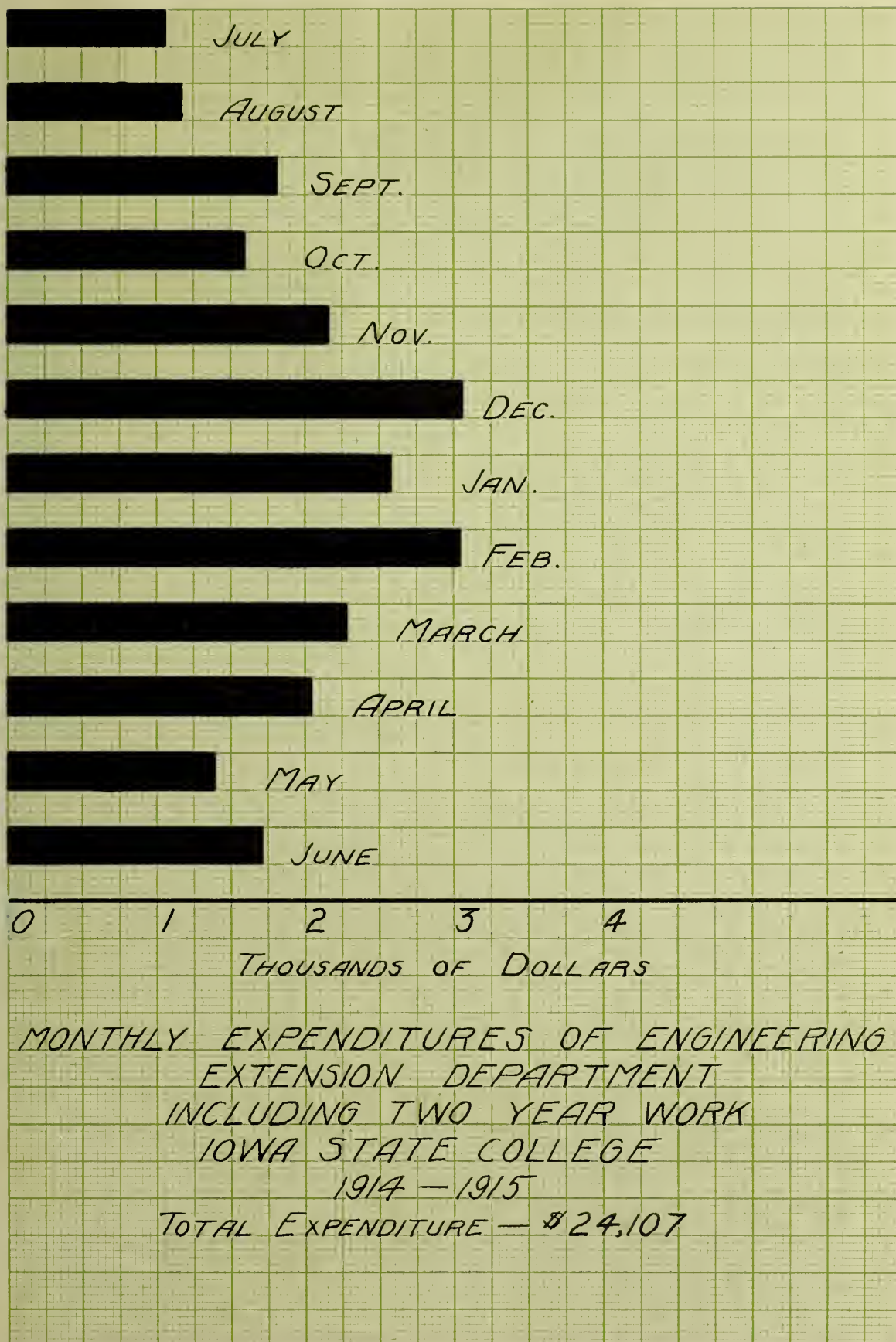


Figure 8.

CHAPTER III.

RESULTS OF ENGINEERING EXTENSION

Extension work in agriculture or engineering which deals directly with the manufacturer and producer has its results measured in dollars and cents, or what is the same thing, in increased productive capacity. The results may be direct or indirect, but in the end they can be definitely and tangibly shown. The employer measures the value of engineering extension so far as it relates to him by the degree in which it enables him to come in touch with better methods and to obtain, keep, and develop efficient workmen. The workman almost invariably measures its value to him in just one way; increased earning power, and the more immediate this result, the better. As his interest increases, however, by reason of results obtained, he becomes more willing to study subjects whose immediate usefulness is not so apparent but which indicate possible lines of development for him in the more distant future.

Results from the Employer's Standpoint.

Employers as a general rule are harder to educate than employees. In the city of Milwaukee, eight years ago, it was with difficulty that a concession of one hour for study every two weeks on company time was granted to men taking en-

gineering extension courses. A year later several employers, in view of results obtained, voluntarily offered to grant one hour every week to their men for study. Two years later three large concerns voluntarily granted five hours a week to their apprentice boys and one hour per week to journeymen. The final result of this work is the present system of continuation schools in Milwaukee and throughout Wisconsin. The fact that more and more time was granted by employers for study indicates clearly that they were getting returns in increased efficiency. One employer in whose plant classes had been running for three years said, "I used to go to Cincinnati for my foremen, now I train my own." Another one, after trying the plan four months said, "I see the difference in my men already". One manager of a very large plant said, "The work furnishes me an excellent sieve. Any man thus sifted out, I keep my eye on. We need him". Men have been recommended time and again from extension classes for advancement and in no case has a man thus recommended failed to make good. The following are some further results in Iowa alone.

(1) The painters course, given first at Ames for a period of one week, has been expanded this year to cover a period of six weeks in two different towns of the state. Master painters in attendance have reported that the instruction has enabled them to do fifty to one hundred percent more of the high class work, formerly done by men from outside of the state. One man reported that he had several large contracts to be turned over to him, provided he could take the course. He took

the course lasting four weeks.

(2) The school for telephone plant men has expanded from a half day session at a convention to four schools of three days each in four different towns of the state. The telephone managers report that these schools are of more immediate benefit to them than resident work in telephone engineering and they are solidly back of both resident and extension work.

(3) The school for telephone operators has increased from four schools to sixteen schools and has been the means of standardizing telephone operation in the state.

(4) The course for janitors and firemen has been paid for by the local school boards and in every case they have reported a saving of more than the cost of the course. There are four requests for continuance of the course for the same men and requests from other school boards to have it given for the first time. One school board reported a saving of 30% in heating one building. A church reported satisfactory operation of a heating plant which, up to the time of the visit of the instructor, had never heated the building. A contemplated expenditure of \$250.00 was found to be unnecessary.

Results from the Workman's Standpoint

That workmen better themselves by study goes without saying and to enumerate examples of salaries raised and benefits derived would savor of patent medicine advertising. A few, however, may not be out of place.

(1) A boy employed as a helper gradually worked up through the shop printing office, blue-print room, and draft-

ing room and is now in the designing office of a large concern. This boy studied faithfully for nearly five years, beginning with the most elementary work.

(2) A foundry apprentice developed considerable skill as a draftsman and on finishing his time went into the drafting room and is now employed as a designer on foundry work.

(3) Cases of machinists, pattern-makers and molders becoming foremen have been numerous. Others have become more efficient in their work, for the effort is not to educate a man out of but into and for his work. One gas engine man says, after four months study, "I now figure out my gasoline for a test. Before it was by guess". Another says "I wish I could have had this course before, so that I could be using it instead of getting it".

(4) A boy in Muscatine, Iowa, has been promoted three times as a result of his work and is now in the architectural department of a large woodworking firm.

Habits of study and reading have been formed leading the man beyond the bare weekly lesson. In one industrial center where the class met at the library, the circulation of industrial books doubled in one year, due to the increased interest in study. In two other cities branch stations were established in different shops, through the efforts of the local instructor. At one of these, twelve out of fourteen books were in circulation all the time. In Des Moines, Iowa, while a course in Heating and Ventilation was in session for twenty weeks, practically all the books on this subject were out of

the library all the time.

Reports of progress to employers are productive of results. A man who knows that his employer is interested in him stays with him for the very good reason that he sees a chance of advancement. The employer therefore has steadier and more loyal workman. The teacher often persuades boys to "stay with it" even through discouragements for the sake of promotion which to them seems slow in coming. One young man of the writer's acquaintance, slow in his studies, stuck to a monotonous job for two years because of the opportunities for study offered by his employer. At the end of that time he became foreman and later superintendent of his department. Three times in two years he would have quit had it not been for the encouragement given by his instructor. Another man was warned that owing to his carelessness an adverse report might go in to "the boss". He remarked, "Hold it up. I'll do better, I would not have that go in for ten dollars".

No one who has worked with and taught shop men and boys, who has seen their ambition kindled and intense earnestness shown and mechanical ability developed ever doubts the results of engineering extension in this field. The relation of teacher and student is far different from that of the college man and his teacher. Between the extension teacher and his student there exists a feeling of equality, friendship and a "cameraderie" unknown elsewhere. Discipline rarely if ever enters in.

Results from the Standpoint of Educational Progress.

The above results may be pointed out as being in part the results of industrial education and not of engineering extension. Engineering extension is often the promoter of industrial education and in this capacity renders a service to the state. The following general educational results may be pointed out in Iowa and Wisconsin.

(1) In Wisconsin the present system of continuation schools is the result of the work first undertaken and promoted as extension work in engineering.

(2) The present school for industrial teachers in Milwaukee is the result of the same work and is still conducted by the Wisconsin Extension Division.

(3) In Iowa the Engineering Extension Department with the assistance of the Agricultural Extension Department shaped the policy of the entire state with regard to the teaching of manual training in rural and small town schools.

(4) In Iowa twenty public schools have undertaken industrial work as a result of engineering extension work. Some have day classes, some night classes, some both. Material for many of these courses is furnished by the Engineering Extension Department. No courses of this character were offered before engineering extension work was started.

(5) Three large manufacturing firms in Iowa have established schools of their own for their men and a fourth is about to establish one.

(6) Three railroads of the state of Iowa make use

of courses prepared by the Engineering Extension Department.

(7) Thirty-six schools of the state of Iowa are using motion pictures as a part of their educational equipment and 500 industrial programs were shown during 1915-1916 by the Engineering Extension Department.

(8) Two text books, one on Carpenters' Arithmetic and one Drawing for Builders have been issued. The sale of these has been large not only in Iowa but in other states.

(9) Schools in two other states have secured information, material and outlines for establishing courses for painters and decorators.

(10) One State Department of Public Instruction secured the course for janitors and firemen and is adapting it to the needs of its own state under its own direction and that of the state college.

(11) There is constant demand for assistance and information on educational motion pictures from public schools and other institutions. This information has been supplied, but no films circulated outside the state.

(12) The work for telephone plant men and telephone operators is being watched by many other states contemplating similar work. The school for telephone plant men in Des Moines enrolled 125 men, all actively engaged in telephone work in the state. The work for operators is standardizing telephone operation in the state. A bulletin is now in progress which will embody the results of co-operation between the Bell and Independent companies of Iowa and the Engineering Extension De-

partment. This will be the standard operating book for the state. The Engineering Extension Department is the intermediary between the Bell and Independent Companies.

Effect of Extension Work on
Resident Departments at Iowa State College.

(1) Two new courses, automobile engineering and telephone engineering have been established as resident courses as a direct result of extension work.

(2) The first winter short courses in engineering were promoted as an engineering extension function. These are now supported by a special fund and have become equal in importance to the agricultural short course. At the last winter short course six hundred were enrolled in engineering subjects.

(3) Members of the engineering faculty have become better acquainted with state problems due to the fact that they have appeared before commercial clubs and farmers' institutes. They have also been placed on the programs of technical societies and industrial organizations, thus widening their acquaintance with state industries and the men engaged in them. That considerable publicity for resident work is thus obtained is evident.

Results of Technical Service Work.

(1) The Technical Service Bureau, after negotiating with the millers of the state, brought eighteen members of the Millers' Club to Ames. After this visit and further consultation, the millers purchased, for installation at the college, an experimental flour mill. With this addition to the chem-

ical equipment, the Experiment station works with the millers on problems of mutual interest.

(2) A list of bulletins published has already been given. These bulletins are in constant demand.

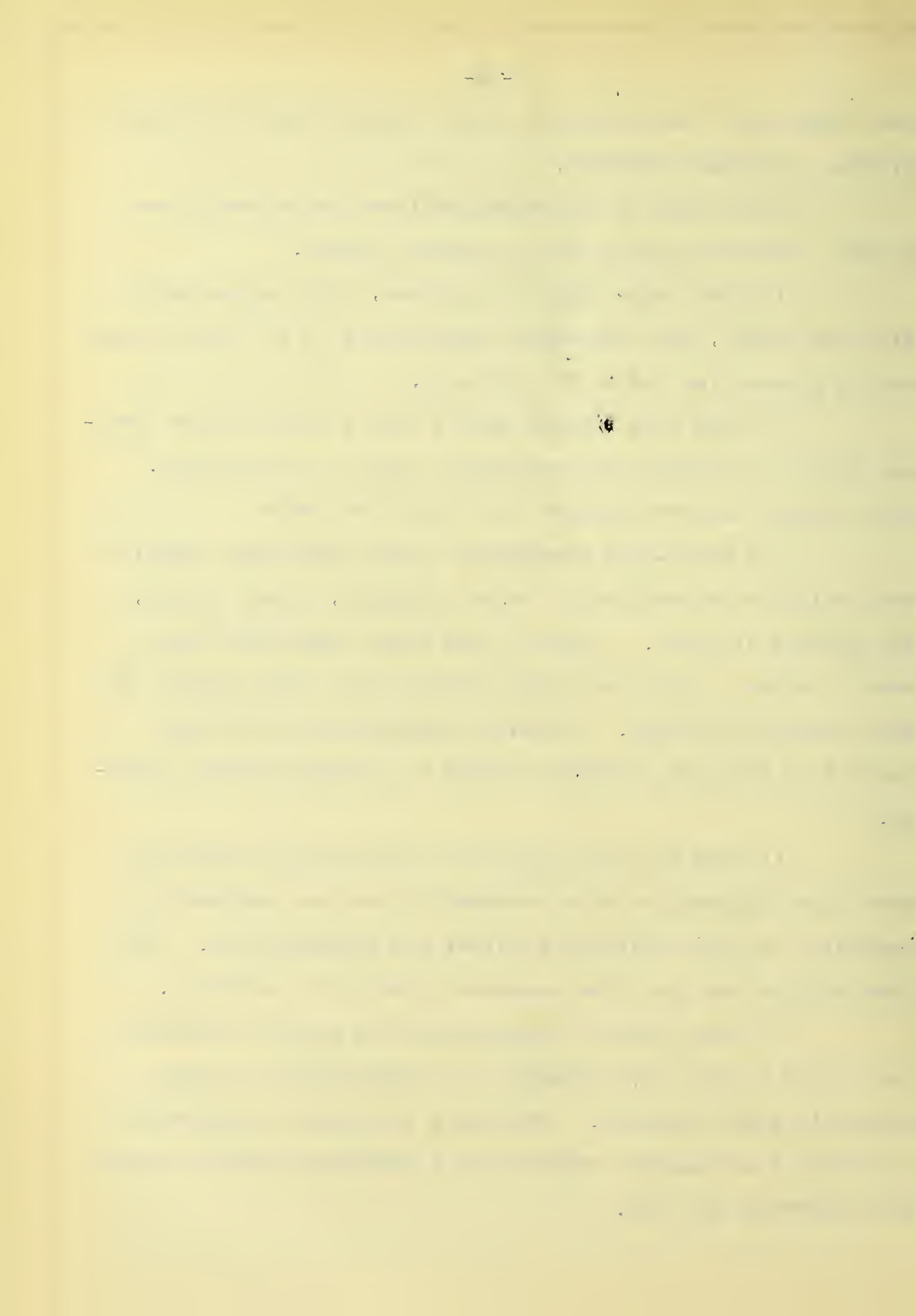
(3) One large city in the state, after consultation with the bureau, has undertaken improvements in its sewer system and is prosecuting the work vigorously.

(4) One city entered upon a half million dollar drainage project following the preliminary report of the bureau. This project had been delayed for forty-five years

(5) Forty-five newspapers of the state were supplied with reliable information on street lighting, street oiling, and garbage disposal. Returns from these towns state that work in street oiling and street lighting has been carried out with excellent results. Clean-up campaigns are now being carried on and more sanitary methods of garbage disposal adopted.

(6) One hundred eighty-five inquiries for definite advice and information were answered in one year exclusive of inquiries on motion picture machines and stereopticons. This does not include inquiries answered directly by bulletins.

(7) One farmers' organization was given information and advice on the establishment of a transmission line for community power purposes. They were persuaded to secure the services of a competent engineer on a percentage basis to plan and supervise the work.



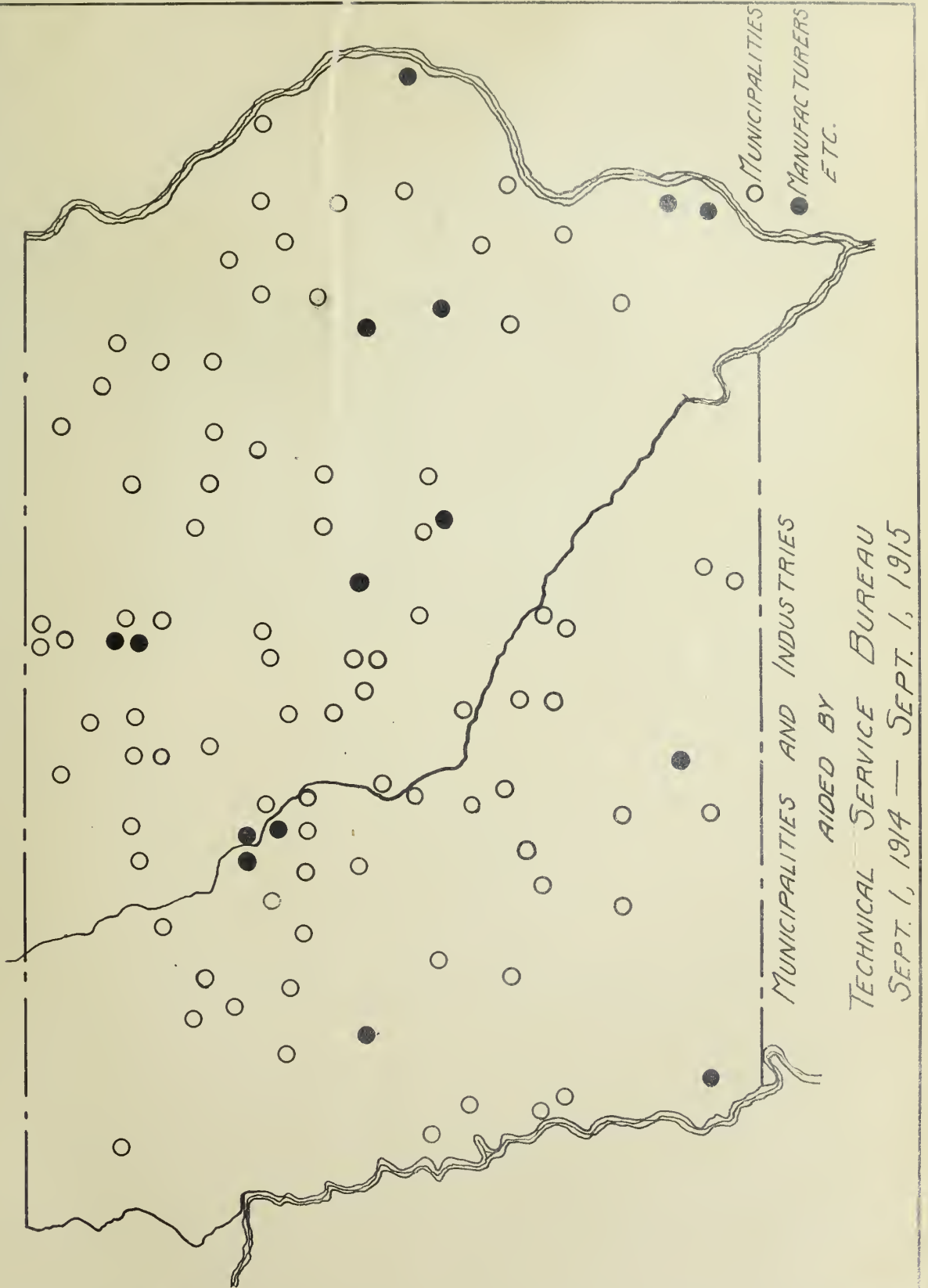


Figure 9.

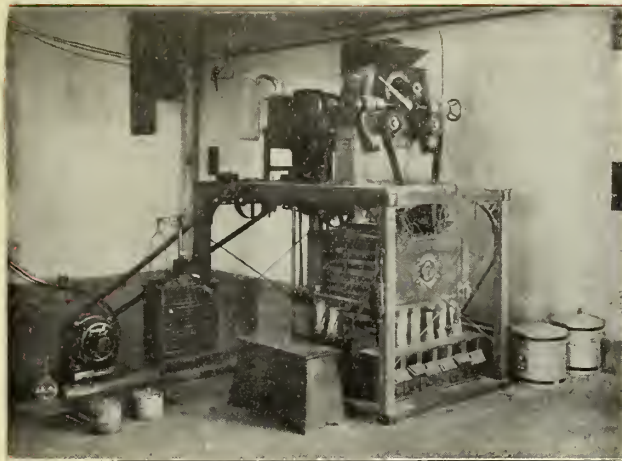


Figure 10.

Experimental Mill Installed by the
Iowa Millers' Club
for
Flour Investigations and Tests.

Engineering Extension as a Field
for the Ambitious Instructor.

Extension work appeals to very few engineering instructors, largely because of the present emphasis on original research work. The man who is quick to see the application of investigation and who can impart his information, may become a good extension man and may do real extension work almost without knowing it.

As to qualifications, there are four which an engineering extension man must have:

- (1) Practical experience
- (2) Analyzing and teaching ability.
- (3) Good health, a strong personality, and tact in meeting men.
- (4) Technical knowledge.

A resident instructor may lack one of the above qualifications and still be successful, due to the fact that he has a powerful organization back of him.

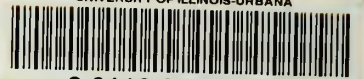
An extension man, dependent more upon himself, must possess all four to be successful. If a man is successful as a resident instructor, it is by no means certain that he can succeed as an extension man, even if he desires to enter upon the work.

For men who can do extension work, what are the rewards? Higher salaries are paid on the average to extension men than to resident men. There is in extension work a broadening influence and a chance for initiative and new work, and plans not found in resident work. The class of men with whom

work is done are more appreciative than college students, provided the work meets their needs. They are far more critical and bitter if dissatisfied, and are harder to satisfy. A sarcastic college man once remarked that the duty of a college professor was to prevent a student's avoiding what he came to college to get. The duty of an extension man is to see that his students get ~~exactly~~ what they come for. If he does this, he will be successful. If he does not, his students will let him know it in no uncertain terms.



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